Executive Summary

As requested by the Environmental Monitoring Advisory Board (EMAB), Slater Environmental Consulting reviewed the *Final Closure Plan – Waste Rock Storage Area – North Country Rock Pile – Version 1.1*. The review focused on the Diavik Diamond Mines Inc.'s (DDMI's) proposed closure criteria for the North Country Rock Pile (NCRP).

Closure planning for the Diavik Diamond Mine (DDM) is following the objectives-based approach that is defined in guidelines prepared by the Mackenzie Valley Land and Water Board. In that approach, closure criteria are the performance indicators and thresholds that are used to determine whether the closure and reclamation activities have met the closure objectives for the DDM. DDMI's proposed closure criteria are listed in Appendix V-1 of the *Final Closure Plan*.

For protecting humans, wildlife and birds, DDMI proposes numerical criteria for contaminants. These criteria are to be applied at locations where people, animals or birds may have access to water including seepage and runoff from the NCRP and water in Lac de Gras. DDMI predicts that concentrations of uranium may exceed these criteria in the runoff and seepage, and for areas of Lac de Gras up to 1 km from the shore of East Island. DDMI states that "*measures may be required to restrict human access to the runoff/seepage to avoid direct consumption*" but does not provide details about what those measures might be, or how they would be extended into Lac de Gras if needed.

For protecting the aquatic ecosystem, DDMI proposes numerical criteria for contaminants. These criteria are to be applied where the runoff and seepage leave the site. The criteria are calculated based on dilution in the lake and contaminant concentrations that will protect the aquatic ecosystem (e.g., fish, benthic invertebrates). The calculations assume that the protective contaminant concentrations can be exceeded for areas within 1 km of East Island. Within this area, there may be long-term effects on the aquatic ecosystem if these criteria are applied. More robust criteria would be beneficial to achieve the objective of providing water quality that will protect the aquatic ecosystem.

For criteria related to landscape design, physical stability and post-closure site appearance, DDMI proposes that following the closure design will be suitable for measuring the success in meeting objectives. DDMI further proposes that reviewers of the design can evaluate how it will perform based on current information. This is only true if the design specifically considers the objectives and provides information to evaluate how well the design achieves each objective. The design provides this information for some objectives but not for others. As a result, DDMI's proposed criterion does not provide a clear indication of what the closure plan is expected to achieve.

DDMI has proposed that monitoring of the NCRP for five-years after completion of closure may be sufficient to evaluate long-term performance. Because some mine closure measures take a long time to reach stable conditions, and because there is uncertainty about long-term performance of some measures, monitoring will likely be required for much longer.

Memorandum

To: John McCullum, Allison Rodvang – Environmental Monitoring Advisory Board

From: Bill Slater – Slater Environmental Consulting

Date: June 25, 2017

Re: Diavik Diamond Mine
North Country Rock Pile – Closure and Reclamation Plan Version 1.1

1.0 Introduction

This memorandum provides the results of Slater Environmental Consulting's (SEC's) review of the closure criteria presented in Diavik Diamond Mines (2012) Inc.'s (DDMI's) *Final Closure Plan – Waste Rock Storage Area – North Country Rock Pile – Version 1.1* (the "FCP-NCRP"). The review was completed to address the scope of work provided by John McCullum in an email dated May 15, 2017, as described in the SEC estimate dated May 24, 2017. Justin Straker (Integral Ecology Group) assisted SEC in the review, following up on review comments and recommendations provided as part of an earlier SEC review.

SEC has provided two previous documents for the Environmental Monitoring Advisory Board (EMAB) addressing the closure criteria for the North Country Rock Pile (NCRP) and the overall closure plan for the Diavik Diamond Mine. These included:

1. A review of closure criteria in the overall *Interim Closure and Reclamation Plan, Version 3.2*, and the *Final Closure Plan – NCRP – Version 1.0*. Results were provided in a memo dated June 15, 2016.
2. Recommendations for revised closure criteria for the overall closure plan and the NCRP. Results were provided in a memo from SEC and Integral Ecology Group, dated March 21, 2017.

For each of the closure objectives that are relevant to the NCRP, Table 1 of this memo lists DDMI's proposed closure criteria from Versions 1.0 and 1.1 of the Final Closure Plan. The Table also describes the differences between the two versions of the criteria, where DDMI has proposed changes. Finally, for some objectives, the Table provides specific recommendations about criteria.

In addition to the content in the table, there are some broader issues that are identified in the scope of work or arose during the review, and some recommendations about criteria that could not be addressed in the Table. These are described in the following sections of this memo:

- Section 2.0 addresses the issue of applying closure criteria to evaluate performance of a system that will take time to stabilize and may change over time.

- Section 3.0 addresses the water quality objective for protecting humans and wildlife (SW1).
- Section 4.0 addresses the water quality objective for protecting the aquatic ecosystem (SW2).
- Section 5.0 addresses objectives where DDMI proposes that conformance with the design is a suitable closure criterion.
- Section 6.0 addresses long-term monitoring and maintenance requirements.

2.0 Timing Issues for Applying Closure Criteria

Closure criteria for the FCP-NCRP need to be considered in the context of their primary function: to evaluate whether the closure activities are complete and have achieved the closure objectives. For mine closure projects however, measuring performance is generally not a one-time event. Even once closure activities are complete, performance is not guaranteed. Some components require time to reach an equilibrium (e.g., frozen cover) and others have uncertainty for long-term performance (e.g., water quality conditions). As a result, it will likely be several years after completion of closure activities before an initial evaluation of some closure criteria will be possible. For others, continued evaluation will be needed over time.

Where evaluation over time is required, for example for water quality and physical stability, there will never be certainty that the closure criteria have been achieved. Instead, continued satisfactory performance over time will provide increasing confidence that the closure landscape and system will continue to provide such satisfactory performance. The ongoing evaluation of performance may also identify areas of uncertainty, but hopefully the range of uncertainty will narrow as the extent of experience increases. Any agreement that the closure outcomes have achieved closure criteria and objectives will have to address outstanding uncertainty, even if there are clear objective criteria for measuring success.

3.0 Water Quality – Safe for Humans and Wildlife

Objective SW1 aims to ensure that surface runoff and seepage water quality is safe for humans and wildlife. Tables V3, V4 and V5 in Appendix V-1 of the FCP-NCRP list DDMI's proposed criteria respectively for drinking water, birds and mammals. These are based on the Site-Specific Risk-Based Closure Criteria (SSRBCC), prepared by ERM and summarized in two 2016 reports (ERM, 2016a and 2016b).

The ERM reports are the same ones submitted with Version 1 of the FCP-NCRP, and have not been updated to address any comments or input received. This includes comments prepared by Ms. Jennifer Kirk of Arcadis, on behalf of the EMAB. In the June 2016 response to reviewer comments, DDMI stated that the SSRBCC Phase II report would be updated to address comments (in Wek'eezhii Land and Water Board, 2016). At the same time, DDMI provided revised criteria to address some calculation errors. The criteria proposed in the FCP-NCRP V.1.1 do not appear to include the June 2016 corrections. The SEC March 2017 memo identified the following discrepancies which have not been addressed in the proposed criteria:

- Nitrate criterion should be adjusted to account for calculation error, and to include risks to toddlers who are more sensitive than adults.
- Antimony criterion should be adjusted to account for calculation error.
- Manganese criterion should be adjusted to account for calculation error, and to include risks to toddlers who are more sensitive than adults.

In addition, DDMI appears to have removed some contaminants from the list of criteria, including copper, lead and zinc. A rationale should be provided or criteria for these contaminants should be retained.

As stated in SEC's March 2017 memo, DDMI's methodology for developing the criteria for SW1 appears reasonable for defining maximum concentrations of contaminants in water for the purpose of protecting humans, birds and wildlife. Because these criteria were developed using a risk-based approach, the site should be managed to avoid exceeding these criteria. To do this, the application of the criteria should be supported by monitoring and adaptive management plans that monitor source and receiving water conditions, and define action thresholds that will trigger timely response actions. The thresholds and actions must be designed to curtail any water quality trends before the maximum criteria are reached.

The updated CRP provides improved definition of the location where the criteria would be applied. For humans,

> *"These criteria are applicable where water could be consumed by people. For the NCRP this would include direct consumption of seepage/runoff or consumption of Lac de Gras water in proximity to where the seepage/runoff was released." (Appendix V-1, Section 3.)*

For birds and wildlife, the criteria would be applicable where birds or mammals would be exposed to water, including possible direct exposure to seepage and runoff as well as in Lac de Gras.

DDMI predicts that, with the exception of uranium, the human health criteria can be achieved "locally" within Lac de Gras, though the extent of likely exceedance is not specified. For uranium, DDMI predicts that the criterion can be achieved in Lac de Gras within 1 km of East Island, and that "*measures may be required to restrict human access to the runoff/seepage to avoid direct consumption*." If the exceedances extend beyond a small local area in Lac de Gras, as the predictions indicate they may for uranium, then measures may also be required for Lac de Gras. While measures to restrict human access to direct consumption of runoff/seepage are likely practical, they may be unrealistic for an area that extends up to 1 km around East Island in Lac de Gras, especially if the restrictions are required for the long-term. The proposed criterion for uranium should be reconsidered unless practical measures can be identified to mitigate potential effects.

As discussed at the June 16 EMAB meeting, the predictions of contaminant concentrations are based on current baseline conditions and do not appear to consider accumulation of contaminants in Lac de Gras over an extended period of time. If mine-related loading increase lake concentrations over time, then the dilution available in Lac de Gras may decrease, leading to

exceedance of acceptable contaminant concentrations. This highlights the importance of ongoing evaluation of performance after the closure plan is complete.

Since the proposed criteria for humans and wildlife already define maximum concentrations based on risk assessment principles, exceedance should be avoided. Instead, the response to any exceedance should entail actions to improve the situation, rather than reassessing the risks.

4.0 Water Quality – Protection of Aquatic Life

Objective SW2 is intended to ensure that surface runoff and seepage water quality will not cause adverse effects on aquatic life or water uses in Lac de Gras or the Coppermine River. Table V2 in Appendix V-1 of the FCP-NCRP lists DDMI's proposed criteria for protection of aquatic life. DDMI's proposed criteria are calculated based on the aquatic benchmarks defined in the approved Aquatic Effects Monitoring Program. The calculation assumes a dilution ratio of 85:1 within Lac de Gras, and applies that dilution at a distance of 1 km from the shore of East Island. The calculation also assumes that no effects at these locations would occur unless contaminant concentrations exceed the benchmarks by 20% or more. With these assumptions, DDMI calculates criteria that would define the concentrations of contaminants at the point of release from the site.

The DDMI decision to establish criteria that rely on the aquatic effects benchmarks rather than the *Metal Mining Effluent Regulations* (MMER) is an improvement from the previous version of the FCP, making the criteria more relevant to the stated objective. The aquatic effects benchmarks are based on the Canadian Water Quality Guidelines for Protection of Aquatic Life (CCME) and Procedures for Deriving Site Specific Water Quality Objectives (CCME). The CCME Guidelines and Procedures are national guidelines and methods that are specifically aimed at defining conditions that are protective of aquatic life. Thus, they are directly relevant to Objective SW2, something that the MMER-based criteria were not. As described in the AEMP Study Design, these benchmarks "*represent levels of water quality variables below which a body of water is expected to be suitable for its designated use*" (Golder Associates, 2016).

Despite the decision to rely on aquatic effects benchmarks to help define the criteria, there are several issues that warrant further consideration.

The proposal to apply the aquatic effects benchmarks at a distance of 1 km from the shore of Lac de Gras leads to the conclusion that the stated objective, water quality that is protection of aquatic life, may not be achieved for substantial areas near East Island in Lac de Gras. Areas with water quality exceeding the benchmark may even extend beyond the 1 km zone because DDMI calculated the proposed criteria based on a threshold that allowed exceedance of the benchmark by 20%.

DDMI argues that the 1 km zone is appropriate because this was considered as the local assessment area during the *Canadian Environmental Assessment Act* (CEAA) environmental assessment in 1999. As stated in Section 9.1 of the FCP-NCRP, the CEAA assessment considered an effect to be significant if it "*has a high probability of a permanent or long-term effect of high magnitude, within the regional*

area." For water quality, a high magnitude effect is one in which the concentration of a contaminant "*exceeds the drinking water and/or the aquatic life guideline by more than 20%*" (FCP-NCRP, Table 9-2). With these assessment thresholds, water quality changes – no matter how large – within 1 km of East Island would never constitute a significant effect.

While CEAA assessors may have established a significance threshold that that was based on the boundary between the local and regional study areas, the location has no ecological relevance. The boundary should not be equated to a suitable threshold for achieving the closure objective which is an ecological objective. The closure plan should be aiming to provide water quality that will not adversely affect aquatic life, rather than aiming to avoid "significant" effects – though of course the avoidance of significant effects still sets a minimum standard for closure performance. Closure criteria should be defined to encourage effective achievement of the objective, rather than to define the tolerable limit for the largest possible adversely affected area in the lake.

DDMI states that the 85:1 dilution factor is the same as that used during the CEAA assessment and that it was "*determined based on modelling of runoff to Lac de Gras and represents the expected level of dilution that would occur within 1 km^2*." Details of modelling are not provided and it is not clear whether the dilution model was developed for mine operations or post-closure conditions. Given that runoff during operations has been controlled, with release of water from a single source (water treatment plant effluent), the modelling conditions for the two phases would likely be quite different. The applicability of the chosen dilution factor to post-closure conditions should be confirmed and demonstrated by providing details of the modelling and assumptions.

Effluent discharge volumes after mine operations cease and after implementation of the closure plan are likely to be much less than during operations. Dewatering of mine areas contributes a significant portion of the current mine effluent and will not be present during the post-operations period. This lower volume of mine effluent that will also be dispersed in several locations should provide for achievement of aquatic effects benchmarks at locations much closer to East Island.

DDMI states that it has not proposed the use of the SSRBCC for protection of aquatic life as due to "significant reluctance to this approach." As stated in the March 2017 SEC memo, the SSRBCC may be relevant for use as secondary criteria within a small zone of influence in Lac de Gras. This approach would likely now be beneficial because DDMI's proposed criteria are calculated based on aquatic effects benchmarks, but are applied to effluent streams. Thus, they do not directly evaluate water quality conditions where effects to aquatic life can occur. Applying the SSRBCC – revised to address concerns raised in previous comments provided – to a small, local zone of influence near discharges would support evaluation of performance for Objective SW2. Because the criteria based on the SSRBCC define maximum acceptable conditions, the monitoring and response framework should be designed to trigger aggressive responses to reduce contaminant loading in the event of any exceedance.

5.0 Conformance with Design

Objectives SW6, SW7, SW9, W1 and W2 define preferred outcomes for landscape design, physical stability and appearance ("aesthetics") of the closed NCRP:

- SW6 is aimed at re-establishing pre-development drainage patterns.
- SW7 is intended to minimize the extent of new land disturbance that is caused by closure activities.
- SW9 encourages the development of landscape features (topography and vegetation) that match aesthetics and natural conditions of the surrounding natural area.
- W1 requires that the NCRP have physically stable slopes to limit risk of failure that would impact the safety of people or wildlife
- W2 is similar to SW9 and encourages the development of rock and till pile features (shape and appearance) that match aesthetics of the surrounding natural area.

For each of these objectives, DDMI proposes a single criterion for evaluating success of the closure and reclamation activities: that the NCRP As-Built Report conforms adequately with the NCRP Closure Design, Appendix X of the FCP-NCRP. In Section 4 of Appendix V-1 of the FCP-NCRP, DDMI proposes that this criterion is sufficient because the "*design has been developed with general consideration of the objectives*," and the review of the design provides an opportunity for "*reviewers to confirm the acceptability of the design, including the acceptability of how well the design aligns with objectives*."

Unfortunately, the NCRP Closure Design does not provide information to conclude that all of the objectives have been considered in developing the design, or for reviewers to evaluate the extent to which the objectives will be achieved if the design is implemented as proposed. Each objective is discussed further below and some specific recommendations are identified in Table1:

- SW6 – Drainage Patterns: The NCRP Closure Design does not address the need to re-establish pre-development drainage patterns. In fact, the design states that "grading to promote drainage will be defined during construction." This does not provide any opportunity for reviewers to consider whether the proposed closure design achieves the objective or not. The design does not include any information allowing a comparison of pre-development and proposed post-remediation drainage patterns.
- SW7 – Extent of New Land Disturbance: The design basis for the NCRP Closure Design identifies the need to minimize the NCRP footprint. Figure 3 and Drawings 2 and 3 illustrate some expected footprints before and after re-sloping. However, there is some inconsistency between the figures and drawings, and there is no clear delineation of the existing extent of the NCRP footprint – just the existing footprint of Type II/III Rock. There is also no specific quantification of the extent of additional footprint expected as a result of re-sloping activities.
- SW9 – Landscape Features (Topography and Vegetation) that Match Aesthetics of Natural Areas: The NCRP Closure Design does not address the aesthetics of the final closed facility,

for either topography or vegetation. Section 5.2.1 of the FCP-NCRP makes it clear that re-vegetation is not part of the closure plan for the NCRP. Similarly, Section 2.4 states that "it is not practical to simulate the natural environment on the NCRP." These statements seem to indicate that DDMI does not intend to achieve objective SW9 with the NCRP closure design. In the context of balancing multiple closure criteria and objectives, and addressing other project drivers (e.g., cost), DDMI's conclusions may not be unreasonable. However, the NCRP Closure Design should be explicit in having considered the objective, and the rationale(s) for choosing not to address it. If this approach is what is proposed, then the closure criterion should be revised to indicate that there is no closure performance threshold for this objective for the NCRP.

- W1 – Physical Stability: The NCRP Closure Design directly considers physical stability and presents analyses that predict stable slopes for the completed facility. The analyses identify potential failure mechanisms during construction, and the design proposes mitigation to address these issues. These analyses indicate that evaluation of the conformance with the design is a useful initial component of the closure criteria. For this objective, DDMI cites the "Final Geotechnical Inspection by the Engineer of Record" in addition to conformance between the as-built and the design. As stated in previous review memos, the issue of physical stability cannot be evaluated on a one-time basis, certainly not on the timeline of an as-built report or final post-construction inspection. Physical stability issues develop over time, especially when considering soil covers, ice-rich permafrost foundations, and expected freeze-back of waste rock. The thermal modelling, for example, indicates that stable thermal conditions probably won't be reached for at least several years. As a result, physical stability performance must be evaluated over a period of time, and should be evaluated against the key thresholds that are identified in the design. Some specific recommendations are provided in Table 1. For physical stability objectives, it would be useful if the criteria addressed the time period over which satisfactory, stable (i.e., not changing) performance would be required in order to address uncertainty about long-term performance.
- W2 – Rock and Till Features that Match Aesthetics of Natural Areas: See discussion on SW9.

In Appendix V-1 of the FCP-NCRP, DDMI argues that design criteria and closure criteria are different. While I agree that they can be different, it is often reasonable that both design criteria and closure criteria are focused on the same key indicators of performance. In some cases, the thresholds of acceptable performance may be similar or the same, and in other cases they may be different. However, it is not unreasonable to expect that closure criteria include key indicators and thresholds that would allow future reviewers to clearly interpret whether acceptable conditions have been reached. DDMI also argues that some of the criteria may be narrative. This is also not unreasonable, provided that the narrative criteria are focused on relevant indicators and measures. Simple compliance with a design does not pass this test – unless the design itself sets clear post-construction performance indicators and thresholds. As stated in the June 2016 SEC review of closure criteria:

"While construction of facilities in compliance with designs is important, it is only one aspect in a series of actions that will lead to achievement of objectives. Design of mine closure has many uncertainties and compliance with the design does not guarantee satisfactory performance. Criteria should be developed that address the specific types of performance that are desired. Based on these criteria, it will be possible to develop appropriate methods to evaluate whether they have been achieved immediately following construction and that they continue to be achieved throughout the closure and post-closure phases. A final inspection by an engineer is not a criterion, but part of a monitoring program. It offers a one-time characterization of performance, but should be recognized as one part of a monitoring program that will need to evaluate actual performance over time."

6.0 Long-term Monitoring and Maintenance

Appendix VI-2 describes DDMI's proposed post-closure monitoring and reporting for the NCRP. DDMI has assumed 5 years of monitoring from the time the cover is complete, but acknowledges that the duration of monitoring will depend on results of initial monitoring programs. This assumption appears to be based primarily on physical performance of the facilities, but does not necessarily consider broader environmental performance.

Monitoring programs should continue until facilities demonstrate stable (i.e., not trending or erratic) performance over a reasonable time period. The period should be long enough to substantially reduce uncertainty about long-term performance. If facilities must achieve critical performance outcomes permanently (e.g., dams) then monitoring and maintenance requirements must reflect this need.

In the case of the NCRP, the key performance outcomes that require long-term consideration are related to physical stability and water quality. The physical stability analyses provided in the FCP-NCRP indicate that performance for overall physical stability can be evaluated in a relatively short time frame after construction. This time period is likely still longer than 5 years because settlement of waste rock may still be occurring at that time.

Cover integrity, on the other hand, needs to be evaluated and monitored over a much longer time period. The primary function of the cover is to eliminate exposure to contaminants in Type II and Type III waste rock. To achieve this function, the cover must remain intact and its lower materials must freeze and remain below the active layer. The thermal modelling provided in Appendix XI (e.g., Figures 15 and 16) indicates that it could take many years to reach stable thermal conditions. Performance in the face of uncertain climate conditions will also be required. Finally, the erosion of cover materials could also compromise cover integrity over a long period of time. Monitoring for physical and thermal cover integrity should likely continue for decades at least.

Potential migration of contaminants from Type II and Type III waste rock into water is a primary driver for the NCRP closure design. The release of contaminants from potentially acid generating waste rock can be a slow process due to the time for oxidation reactions to happen, followed by

consumption of neutralizing materials. The release to receiving environments or at the toes of waste rock dumps is also delayed by wetting up of materials and travel times in groundwater. In the case of the NCRP, frozen conditions should also delay or stop the movement of contaminants. With all of these factors, water quality conditions could take many years to stabilize, and they could also change after many years of stable conditions. Like monitoring of cover integrity, water quality monitoring is also likely required for a period of at least decades.

7.0 Closing

Thank you for the opportunity to continue working with the EMAB on this project. If you have any questions about the findings or recommendations, I would be happy to discuss them with you.

Sincerely,

Bill Slater

Table 1: Closure Criteria – Final Closure Plan, North Country Rock Pile, Versions 1.0 and 1.1

Closure Objective	DDMI 2016 Criteria (Version 1.0)	DDMI 2017 Criteria (Version 1.1)	Changes and Recommendations
Site Wide Objectives			
SW1. Surface runoff and seepage water quality that is safe for humans and wildlife.	Table V-3 in FCP-NCRP 2016. Based on SSRBCC.	Tables V3, V4 and V5 in FCP-NCRP 2017. Based on SSRBCC.	Minor changes from 2016. See Memo Section 3.0.
SW2 Surface runoff and seepage water quality that will not cause adverse effects on aquatic life or water uses in Lac de Gras or the Coppermine River.	Table V-3 in FCP-NCRP 2016. MMER Standards	Table V2 in FCP-NCRP 2017. Calculated based on Aquatic Effects Benchmarks.	Significant changes from 2016. See Memo Section 4.0. Thermal performance of the NCRP cover is critical for achieving this objective, and will provide the earliest line of evidence that the control system for water quality has failed. Maintaining frozen conditions within the cover could be used as a criterion for measuring performance of this objective. However, it is not a direct measurement. DDMI has proposed installation of equipment to monitor thermal performance and proposes monitoring as part of the post-closure monitoring program. Comments in Section 6.0 of this memo are relevant to evaluating performance.
SW3. Dust levels safe for people, vegetation, aquatic life, and wildlife.	Mean TSP concentrations less than 60 *u*g/m3 annual and 120 *u*g/m3 24 hr maximum acceptable (Canadian Ambient Air Quality Objectives and NWT Ambient Air Quality Standards).	Mean TSP concentrations less than 60 ug/m_3 annual and 120 ug/m_3 24 hr maximum acceptable (Canadian Ambient Air Quality Objectives and NWT Ambient Air Quality Standards).	No change since 2016. Comments provided in March 21, 2017 SEC memo are still relevant and are repeated below. Criteria should focus on post-closure concentrations of dust within and around the mine footprint. Criteria specified in the Canadian Air Quality Standards are health-based air quality objectives and address the objective with respect to safety for humans. Long-term safe dust levels for vegetation, aquatic life and wildlife should be based on comparison with reference conditions (pre-mine levels or measurements from outside the fugitive-dust footprint). The following criteria should apply. 1. Total Suspended Particulate (TSP) • 24-hr average: 120 µg/m^3 • Annual mean: 60 µg/m^3 2. Fine Particulate Matter ($PM_{2.5}$) • 24-hr average: 28 µg/m^3 • Annual mean: 10 µg/m^3 3. Return dust concentrations in the mine footprint and surrounding area to levels that are not significantly different from concentrations in relevant reference areas.
SW4. Dust levels do not affect palatability of vegetation to wildlife.	Monitoring evidence of post-closure wildlife use of area.	Monitoring evidence of post-closure wildlife use of area.	No change since 2016. Comments provided in March 21, 2017 SEC memo are still relevant and are repeated below. Criteria associated with objective SW4 should be focused on two different factors, noting that caribou are a focal receptor: 1. Measurements of post-closure deposition of fugitive dust. This is already proposed in association with objective SW3. For objective SW4 thresholds for the criterion should be based on reference conditions (pre-mine levels or measurements from outside the fugitive-dust footprint). The expectation would be a return to levels equivalent to pre-mining within a certain period from closure,

Table 1: Closure Criteria – Final Closure Plan, North Country Rock Pile, Versions 1.0 and 1.1

Closure Objective	DDMI 2016 Criteria (Version 1.0)	DDMI 2017 Criteria (Version 1.1)	Changes and Recommendations
			with regular monitoring and reporting on observed trends. Although Golder (2013) report declining dust levels from dustfall monitoring, they also state that dust levels are still five times higher than reference values. Another indicator for this criterion could be concentrations of elements of interest in lichen tissues within the mine's zone of influence. Golder report: 1) an observation by Elders from the Tłı̨chǫ and Łutsel K'e communities that lichens adjacent to the mine (near-field sampling locations) are of poorer forage quality for caribou than those in far-field sampling locations, which they attribute to dust deposition; 2) an observation by Elders that caribou use of the near-field sites is absent or reduced compared to pre-development conditions; and 3) significantly higher element concentrations in near-field lichen samples as compared to far-field samples (for aluminum, antimony, bismuth, cadmium, chromium, cobalt, copper, lead, molybdenum, nickel, strontium, thallium, uranium, and vanadium). Sampling at three-year intervals should be continued, and the criterion should be a return to concentrations in the majority of the above listed elements for near-field samples that are not significantly higher than those in far-field samples, using the current sampling design. 2. Assessment of post-closure habitat use. Current and historic work at Diavik has used a zone-of-influence (ZOI) approach, where a reduction of use is documented by wildlife species in a defined area around the operating mine site. DDMI indicates that this ZOI exists primarily due to sensory disturbances such as noise and odours that will cease following closure (e.g. the NCRP Final Closure Plan V1.0, p. 66). Therefore a criterion for wildlife use, including avoidance of use due to dust deposition, could be based on the ZOI decreasing to a stated area over a stated post-closure timeframe. Additional work would be required to develop this criterion and its associated indicators and thresholds. The ZOI approach will not be causally linked to individual factors such as vegetation palatability, but will be required to assess overall use/avoidance of the site by wildlife.
SW6. Ground surface designed to drain naturally follow predevelopment drainage patterns.	NCRP As-Built Report conforms adequately with Golder (2016)	NCRP As-Built Report conforms adequately with Golder (2016).	Assume 2017 reference should be to Golder 2017. Otherwise, no change since 2016. See Memo Section 5.0.
SW7. Areas in and around the site that are undisturbed during operation of the mine should remain undisturbed during and after closure.	NCRP As-Built Report conforms adequately with Golder (2016)	NCRP As-Built Report conforms adequately with Golder (2016).	Assume 2017 reference should be to Golder 2017. Otherwise, no change since 2016. See Memo Section 5.0.
SW8. No increased opportunities for predation of caribou compared to pre-development conditions.	No monitoring evidence of recurring predation directly associated with an aspect of the NCRP.	No monitoring evidence of recurring predation directly associated with an aspect of the NCRP.	No change since 2016. Comments provided in March 21, 2017 SEC memo are still relevant and are repeated below. DDMI should provide additional information to support development of an effective criterion that links directly to the agreed-on objective, including: 1. An analysis of specific opportunities for caribou predation in the pre-development environment, and of how these might be expected to change following closure. 2. A corresponding proposed criterion that includes indicators, measurement methods, and thresholds against which indicators can be tested to demonstrate achievement of the criterion.

Table 1: Closure Criteria – Final Closure Plan, North Country Rock Pile, Versions 1.0 and 1.1

Closure Objective	DDMI 2016 Criteria (Version 1.0)	DDMI 2017 Criteria (Version 1.1)	Changes and Recommendations
			This analysis will have to be conducted with reference to wildlife-use/ZOI studies, as lack of predation may result from lack of site use, rather than or in addition to from appropriate design. SW8 site-wide closure objective and associated closure criteria as described currently do not have effective indicators that are measurable, do not have identified thresholds, and do not appear to support a timely response. It should be noted that some closure design elements appear to be potentially contradictory to objective SW8. Specifically, the NCRP Closure Plan proposes to build steep, snow-accumulating areas to provide denning opportunities for a variety of species, including wolves. Design of habitat elements for the primary caribou predator – if effective – may not be compatible with the objective of not increasing predation opportunities on the post-closure landscape.
SW9. Landscape features (topography and vegetation) that match aesthetics and natural conditions of the surrounding natural area.	NCRP As-Built Report conforms adequately with Golder (2016)	NCRP As-Built Report conforms adequately with Golder (2016).	Assume 2017 reference should be to Golder 2017. Otherwise, no change since 2016. See Memo Section 5.0.
SW10. Safe passage and use for caribou and other wildlife.	No repeated harm to caribou as a direct result of passage through or use of the NCRP. (i.e. if a feature of NCRP is confirmed as being a hazard based on more than one incident then objective is not met for that feature)	No repeated harm to caribou as a direct result of passage through or use of the NCRP. (i.e. if a feature of NCRP is confirmed as being a hazard based on more than one incident then objective is not met for that feature)	No change since 2016. Comments provided in March 21, 2017 SEC memo are still relevant and are repeated below. 1. DDMI's proposed criterion appears to be appropriate, but should be linked to an explicit identification of potential hazards to passage and use for caribou and other wildlife, and a detailed plan for assessment and monitoring of these hazards. In addition, an assessment of safe passage and use should be coupled with the analysis of ZOI proposed for objective SW4, which will provide landscape-level data on wildlife use of the post-closure site. 2. The criterion (or criteria) and its (their) attendant indicators should be explicitly linked to adaptive-management responses. The proposed criterion indicates how to assess whether or not the objective has been met for a feature, but not what mitigation will be applied in the event of such an assessment.
Waste Rock and Till Area Objectives			
W1. Physically stable slopes to limit risk of failure that would impact the safety of people or wildlife	NCRP As-Built Report conforms adequately with Golder (2016). Final Geotechnical Inspection by Engineer of Record	NCRP As-Built Report conforms adequately with Golder (2016). Final Geotechnical Inspection by Engineer of Record	Assume 2017 reference should be to Golder 2017. Otherwise, no change in criterion since 2016. Actions now refer to "Geotechnical Inspections" in addition to "Reclamation Completion Report." Comments provided in March 21, 2017 SEC memo are still relevant and are repeated below. The following criteria should be considered to address specific factors related to physical stability of mine areas, and associated impacts on safety: 1. Grading and Settlement: Grading avoids creation of ponded water and differential settlement does not result in ponded water, except in locations where designs plan for the presence of standing water. 2. Waste Rock and Till Slope Stability: Slopes of 3:1 or flatter for areas that require cover placement or with ice-rich foundations. Slopes of 1.3:1 or flatter for all areas. Confirmation that slopes remain stable over time.

Table 1: Closure Criteria – Final Closure Plan, North Country Rock Pile, Versions 1.0 and 1.1

Closure Objective	DDMI 2016 Criteria (Version 1.0)	DDMI 2017 Criteria (Version 1.1)	Changes and Recommendations
			3. Waste Rock and Till Slope Creep: Creep rate no greater than 0.01 m/m/year for any self-supporting mine facility on ice-rich foundations. 4. Erosional Stability: No gullies or significant rills on mine facilities or mine disturbed areas during post-closure phase, or evidence of sediment plumes from mine facilities. Total suspended solids (TSS) < 15 mg/L monthly average in all mine discharges. Wildlife Hazards: Any hazards to wildlife removed or addressed. Rationale for each numbered criterion as follows: 1. In accordance with NCRP closure design to limit ponding of water on cover materials, and promote water flow towards collection ponds. This same criterion is likely applicable for all mine areas. 2. As per NCRP closure design, slopes are required for stability, cover construction, and for reducing potential creep in areas of ice-rich permafrost. 3. Consistent with creep threshold applied in creep analysis for NCRP closure. 4. Intention is to reduce erosion to rates that are similar to natural environments – necessary for defining a long-term sustainable landscape. TSS standard is based on MMER. 5. As per ICRP. Evaluating performance of the criteria for physical stability will require a program for monitoring and observation. For some criteria (e.g. slope stability and creep rates), specific monitoring instrumentation may be required. For other criteria (e.g., ponding of water), observation by qualified professionals should be used to confirm compliance.
W2. Rock and till pile features (shape and appearance) that match aesthetics of the surrounding natural area	NCRP As-Built Report conforms adequately with Golder (2016)	NCRP As-Built Report conforms adequately with Golder (2016)	Assume 2017 reference should be to Golder 2017. Otherwise, no change since 2016. See Memo Section 5.0.
W3. Contaminated soils and waste disposal areas that cannot contaminate land and water	NCRP As-Built Report conforms adequately with Golder (2016)	NCRP As-Built Report conforms adequately with Golder (2016)	Assume 2017 reference should be to Golder 2017. Otherwise, no change since 2016. Comments provided in March 21, 2017 SEC memo are still relevant and are repeated below. 1. Soil Contaminants: Soil criteria listed in Table 4 of the March 21, 2017 SEC memo. 2. Grading and Settlement: Grading avoids creation of ponded water and differential settlement does not result in ponded water. 3. Erosional Stability: No gullies or significant rills on disposal areas during post-closure phase. Total suspended solids (TSS) < 15 mg/L monthly average in all mine discharges. Soil criteria are the SSRBCC (ERM. 2016b). Physical criteria address potential physical safety issues.

8.0 References

ERM Consultants Canada Ltd. (ERM). 2016a. *Diavik Diamond Mine, Site-specific Risk-based Closure Criteria, Phase I Report.* Prepared for Diavik Diamond Mines (2012) Inc.

ERM Consultants Canada Ltd. (ERM). 2016b. *Diavik Diamond Mine, Site-specific Risk-based Closure Criteria, Phase II Report*. Prepared for Diavik Diamond Mines (2012) Inc.

Golder Associates. 2016. *Diavik Diamond Mines (2012) Inc., Aquatic Effects Monitoring Program Design Plan, Version 4.0*. Submitted to Diavik Diamond Mines (2012) Inc.

Wek'eezhii Land and Water Board. 2016. *Review Comment Table, Diavik Risk Based Closure Criteria Report (W2015L2-0001).*